



University of Pittsburgh

Information Technology

COMPUTING SERVICES AND SYSTEMS DEVELOPMENT

Campus Cyberinfrastructure – the Science DMZ Role of Research and Education Networks

Brian Stengel, Computing Services and Systems Development

March 5th, 2015



Agenda

- Campus Cyberinfrastructure
- Recent NSF Award - ScienceDMZ
- Research and Education Networks (RENs)
- National Cyberinfrastructure
- Statewide REN – PennREN



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Technology Training

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24x7 online technology training

Alerts & Notifications

Thursday, November 6, 2014 - 11:21am
 Drupal Vulnerability Could Allow Compromise of Web sites
 Vulnerability could allow potential compromise of Drupal Web sites.

Friday, October 31, 2014 - 3:46pm

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Our Organization

CSSD is the central IT organization for the University of Pittsburgh. We provide innovative information technology services to support learning, teaching, research, and business functions. Explore the sections below to learn more about us!

Overview

Innovative technology services for the University of Pittsburgh.

[Technology Services](#) [CSSD](#) [IT](#) [Academic Courseware](#)

Office of the CIO

Profile: Jinx P. Walton, CIO

[Office of the CIO](#) [Jinx Walton](#) [CIO](#) [CSSD](#)

Awards and Recognition

Local and national recognition we've received.

[Award](#) [CSSD](#)

Strategic Plan: 2012-2015

Pitt's information technology foundation for the 21st century.

[Strategic Plan](#) [Technology](#) [CSSD](#)

Connect to PittNet

Fast, secure, and easy-to-use wireless Internet access.

[Wireless PittNet](#) [Wireless WiFi](#)

Enterprise Business Intelligence

Data-driven decision-making.

[Data Warehouse](#)

Academic Courseware for Faculty

Our Shared Responsibility

Cyber Security Awareness

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Alerts & Notifications

- Tuesday, February 10, 2015 - 4:48pm
February Microsoft Security Bulletins
 Three critical vulnerabilities affect Microsoft Windows and Internet Explorer.
- Tuesday, January 27, 2015 - 5:02pm
GHOST Vulnerability Affects Linux Computers
 A critical new vulnerability in the GNU C Library affects most versions of Linux.
- Tuesday, January 27, 2015 - 11:21am
Phishing Alert: Capital One Account Suspension
 Email scam attempts to convince you to reply with your SSN and other info to unlock your account.

[More >](#)

Features & Feedback

Wireless Feedback

Share your comments or suggestions about wireless service.

Check Lab Availability

See which labs have room - before you get there!

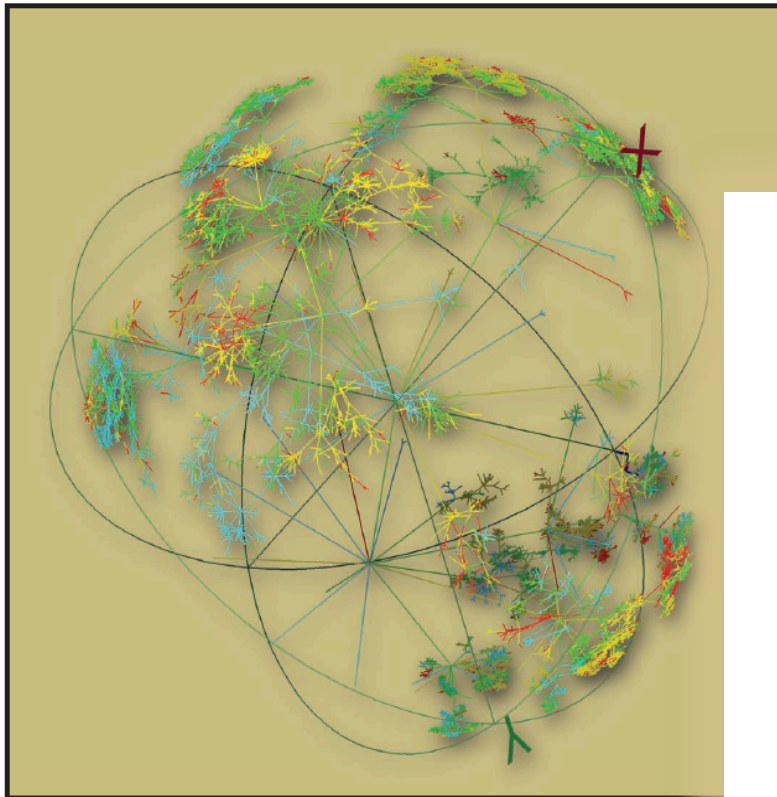


Information Technology Services

- **Enterprise Services**
 - Accounts/Identity Services
 - Enterprise Web Infrastructure
 - Data/Voice/Wireless Networking
 - Information Security Services
 - Data Center/NOC Services
 - Server hosting, VMs, managed services
- **Student Computing**
 - Labs, Services, Consulting
 - LMS, Learning, Training
 - Software
- **Enterprise Systems**
 - Email
 - my.pitt.edu
 - Business systems
- **Operations**
 - 24x7 NOC
 - Network, Voice, Systems Engineering
- **Support Services**
 - 24x7 Help Desk
 - Consulting Services
- **Security**
 - Security engineers and response
- **Business Intelligence**
 - Data Warehouse
 - Analytics
- **Research Support**
 - HPC hosting, HPC engineers
 - FISMA compliant environment
 - RENs
 - Proposal support
 - Collaboration opportunities



CYBERINFRASTRUCTURE VISION FOR 21ST CENTURY DISCOVERY



National Science Found
Cyberinfrastructure Co
March

National Science Foundation

CYBERINFRASTRUCTURE VISION
FOR 21ST CENTURY DISCOVERY

March 2007

TABLE OF CONTENTS

LETTER FROM THE DIRECTOR	i
PREFACE	ii
ACKNOWLEDGEMENTS	ii
EXECUTIVE SUMMARY	1

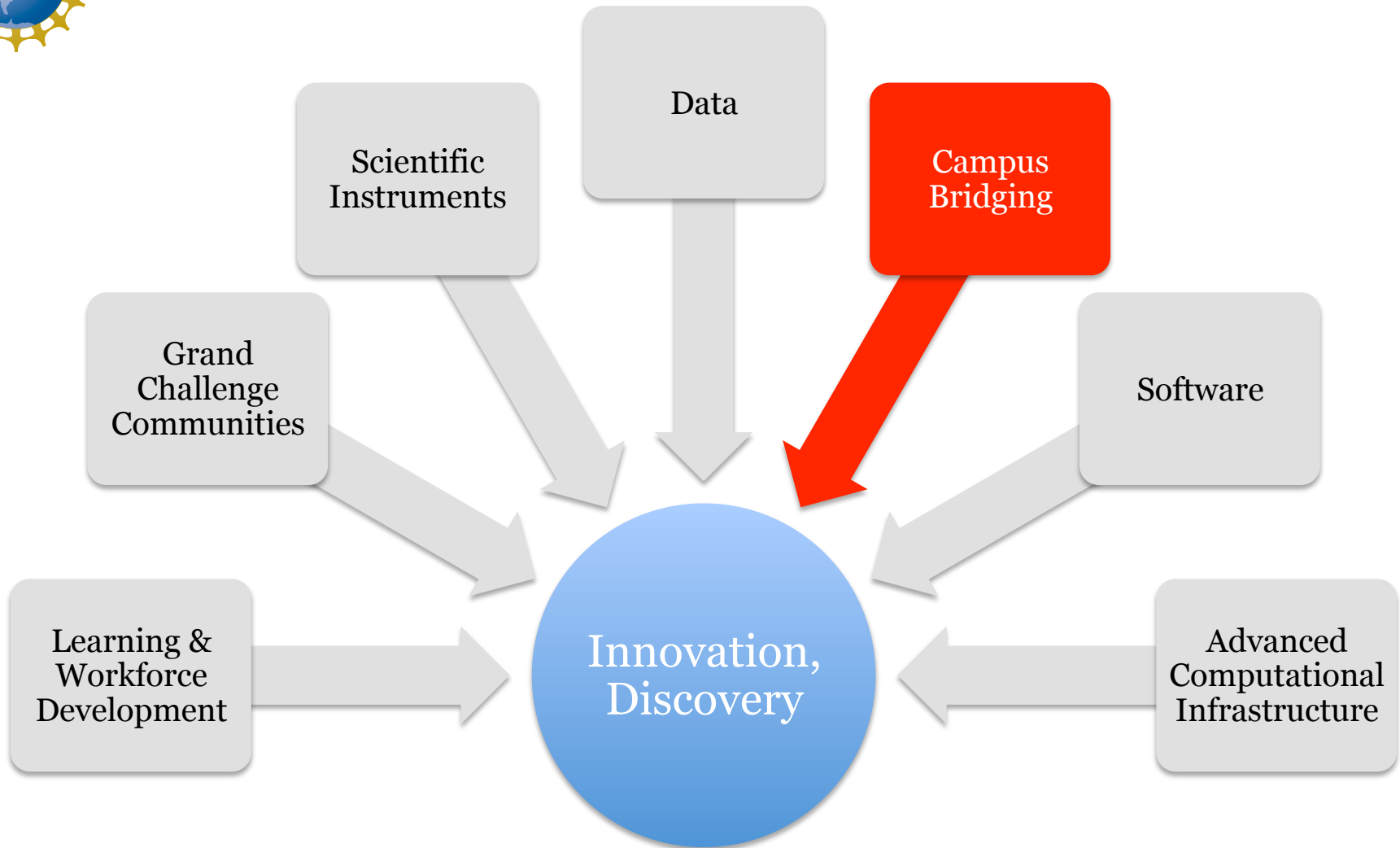
1 CALL TO ACTION	5
I. CYBERINFRASTRUCTURE DRIVERS AND OPPORTUNITIES	5
II. VISION, MISSION AND PRINCIPLES FOR CYBERINFRASTRUCTURE	6
III. GOALS AND STRATEGIES	7
IV. PLANNING FOR CYBERINFRASTRUCTURE	10
2 HIGH PERFORMANCE COMPUTING (2006-2010)	13
I. WHAT DOES HIGH PERFORMANCE COMPUTING OFFER SCIENCE AND ENGINEERING?	13
II. THE NEXT FIVE YEARS: CREATING A HIGH PERFORMANCE COMPUTING ENVIRONMENT FOR PETASCALE SCIENCE AND ENGINEERING	15
3 DATA, DATA ANALYSIS, AND VISUALIZATION (2006-2010)	21
I. A WEALTH OF SCIENTIFIC OPPORTUNITIES AFFORDED BY DIGITAL DATA	21
II. DEFINITIONS	22
III. DEVELOPING A COHERENT DATA CYBERINFRASTRUCTURE IN A COMPLEX GLOBAL CONTEXT	23
IV. THE NEXT FIVE YEARS: TOWARDS A NATIONAL DIGITAL DATA FRAMEWORK	24
4 VIRTUAL ORGANIZATIONS FOR DISTRIBUTED COMMUNITIES (2006-2010)	31
I. NEW FRONTIERS IN SCIENCE AND ENGINEERING THROUGH NETWORKED RESOURCES AND VIRTUAL ORGANIZATIONS	31
II. THE NEXT FIVE YEARS: ESTABLISHING A FLEXIBLE, OPEN CYBERINFRASTRUCTURE FRAMEWORK FOR VIRTUAL ORGANIZATIONS	32
5 LEARNING AND WORKFORCE DEVELOPMENT (2006-2010)	37
I. CYBERINFRASTRUCTURE AND LEARNING	37
II. BUILDING CAPACITY FOR CREATION AND USE OF CYBERINFRASTRUCTURE	37
III. USING CYBERINFRASTRUCTURE TO ENHANCE LEARNING	39
IV. THE NEXT FIVE YEARS: LEARNING ABOUT AND WITH CYBERINFRASTRUCTURE	39



- In 2009, a joint workshop of Educause ACTI-CCI and the Coalition for Academic Scientific Computation (CASC) issued a report and recommendations that addressed the challenges and strategies for developing a **coherent cyberinfrastructure from local campuses to national facilities.**
- The joint report observed that extremely large computing clusters, such as those at federally funded centers, will provide and support excellent scalability for only a very few software applications. The report then noted the proliferation of 1,000–2,000 core clusters on many campuses. The report concluded that it is not only practical but also ***optimal to solve a large number of computational problems at the campus level***

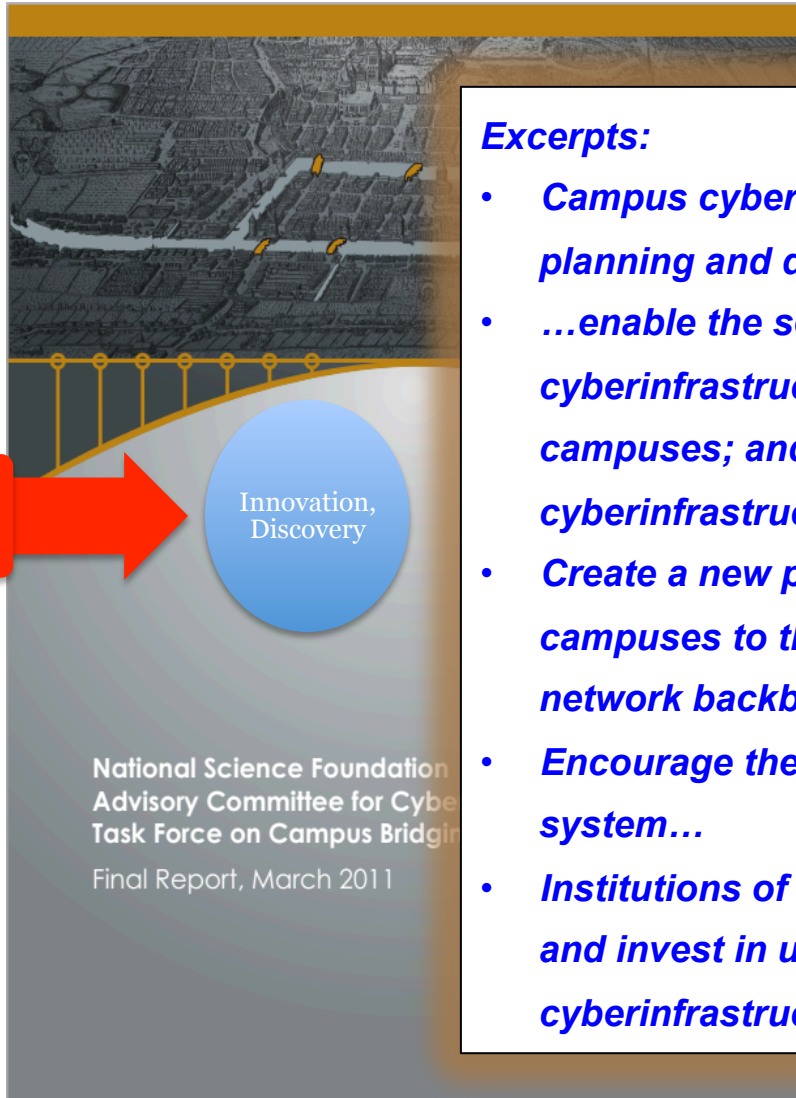


Six task forces charged with investigating long-term cyberinfrastructure issues





Recommendations/Conclusions from the Task Force



Excerpts:

- *Campus cyberinfrastructure cannot be ignored when planning and developing the national cyberinfrastructure*
- *...enable the seamless integration of the scientist's campus cyberinfrastructure; the cyberinfrastructure at other campuses; and regional, national, or international cyberinfrastructure*
- *Create a new program funding high-speed connections from campuses to the nearest landing point for a national network backbone...*
- *Encourage the use of InCommon global federated ID system...*
- *Institutions of higher education should lead efforts to fund and invest in university-specific, state-centric, and regional cyberinfrastructure*



Cyberinfrastructure in action

http://www.nsf.gov/news/special_reports/cyber/

Common Components of Cyberinfrastructure

- Scientific instruments - microscopes, telescopes, NGS units, observatories, distributed cyberinfrastructure
- Computing - high performance computing clusters, supercomputers, private/public/hybrid compute clouds etc...
- Published data sets - repositories, data banks, publicly available, fee based, journals, publications
- Advanced networking - high speed, broadband, optical, software defined, ScienceDMZ
- Software/Middleware - hubs, collaboration tools, identity management, trust solutions, synchronization, transfer tools
- Data management/storage/archival - disk, NAS, cloud, hybrid
- Collaborators - scientists, scholars, professionals, clinicians, systems administrators, librarians
- Colleagues - professors, post-docs, grad assistants, data scientists

Cyberinfrastructure - Discovery and innovation

In scientific usage, cyberinfrastructure is a technological and sociological solution to the problem of efficiently connecting laboratories, data, computers, and **people** with the goal of enabling derivation of novel scientific theories and knowledge. (Source: Wikipedia)

Cyberinfrastructure - Federal funders

United States federal research funders use the term cyberinfrastructure to describe research environments that support advanced data acquisition, data storage, data management, data integration, data mining, data visualization and other computing and information processing services distributed over the Internet **beyond the scope of a single institution**. (Source: Wikipedia)

Cyberinfrastructure – In Practice

IT + more



**ADVANCED
NETWORKING**

*New services,
tools, techniques,
skills*

**CLOUD,
EXCHANGES**

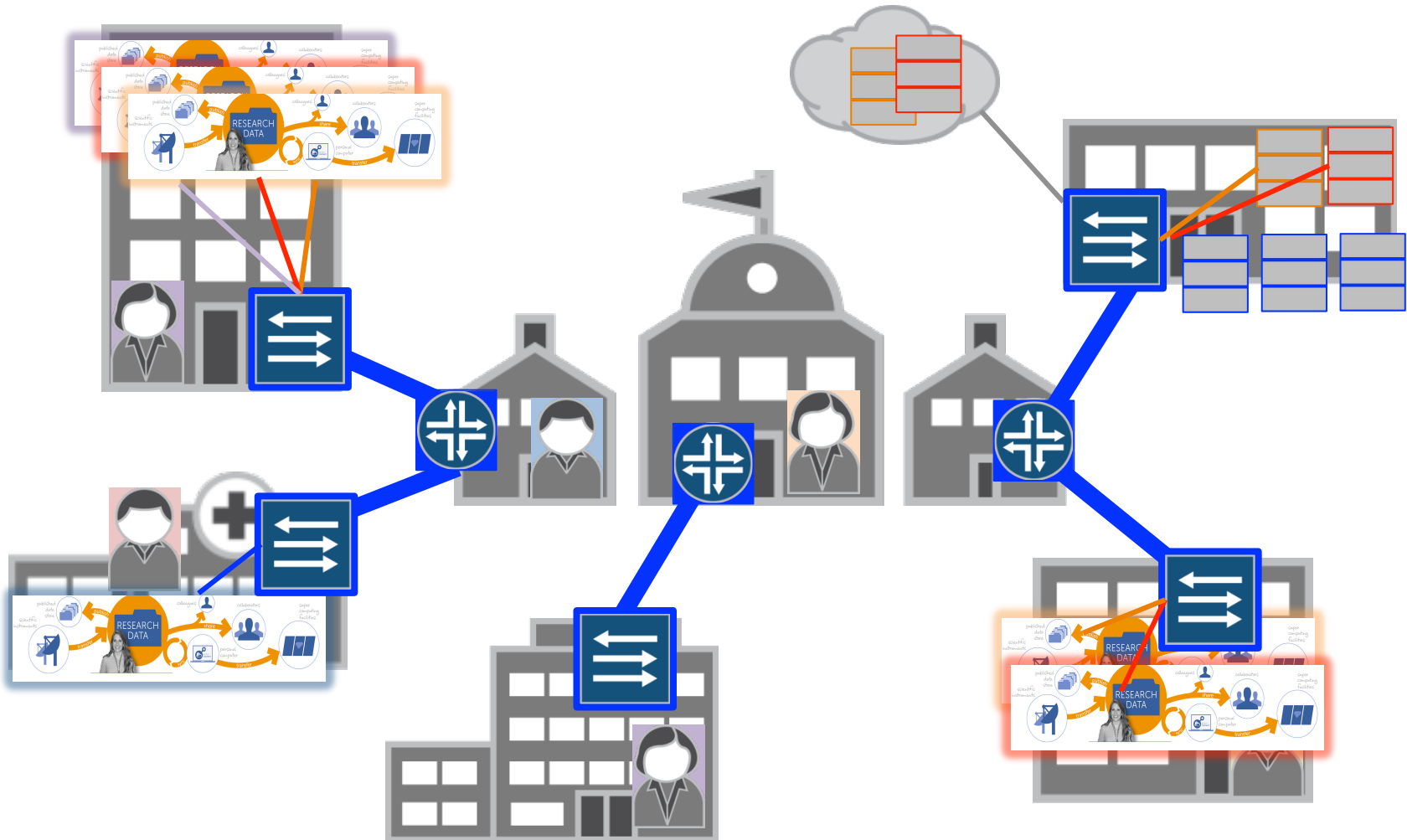
**TRUST
SOLUTIONS**

**COMMUNICATIONS AND
COLLABORATION
TOOLS**

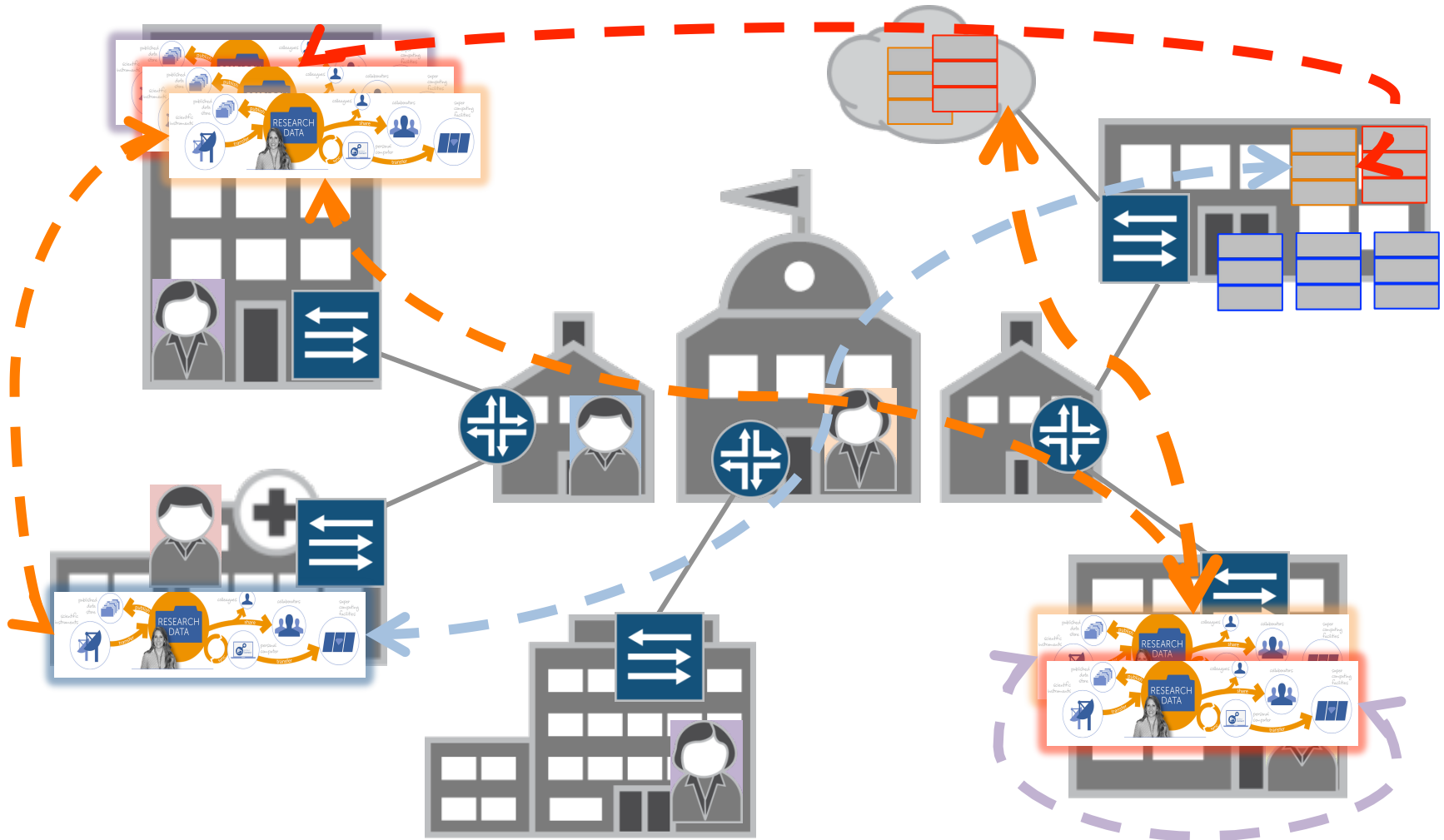
**HIGH
PERFORMANCE
COMPUTING**

**OPERATIONS,
CYBERSECURITY**

Campus Cyberinfrastructure – in the .EDU *enterprise*



Campus Cyberinfrastructure – in the .EDU *enterprise*





Strategic Recommendation to NSF#3

... NSF should create a new program funding high-speed connections from campuses to the nearest landing point for a national network backbone. The design of these connections must include support for dynamic network provisioning services and must be engineered to support rapid movement of large scientific data sets – *pg.6, National Science Foundation Advisory Committee for Cyberinfrastructure Task Force on Campus Bridging, Final Report, March 2011*



Campus Cyberinfrastructure Programs

- 2013 – CC*Network, Infrastructure and Engineering
 - Campus upgrades, new networking technologies development, upgrades to campus cyberinfrastructure
- 2014 – CC*Infrastructure, Innovation and Engineering
 - Emphasis on integration, innovation and demonstrated support for science projects, developing campus CI expertise (human)
- 2015 – CC*Data, Networking, and Innovation
 - Emphasis on data infrastructure building blocks, collaboration, communities engagement



NSF CC*IIE Program

- The NSF's "Campus Cyberinfrastructure - Infrastructure, Innovation and Engineering (CC*IIE)" program invests in **improvements and re-engineering** at the campus level to support a range of data transfers supporting computational science and computer networks and systems research. The program also supports network integration activities tied to achieving higher levels of performance, reliability and predictability for science applications and distributed research projects.



Award Details

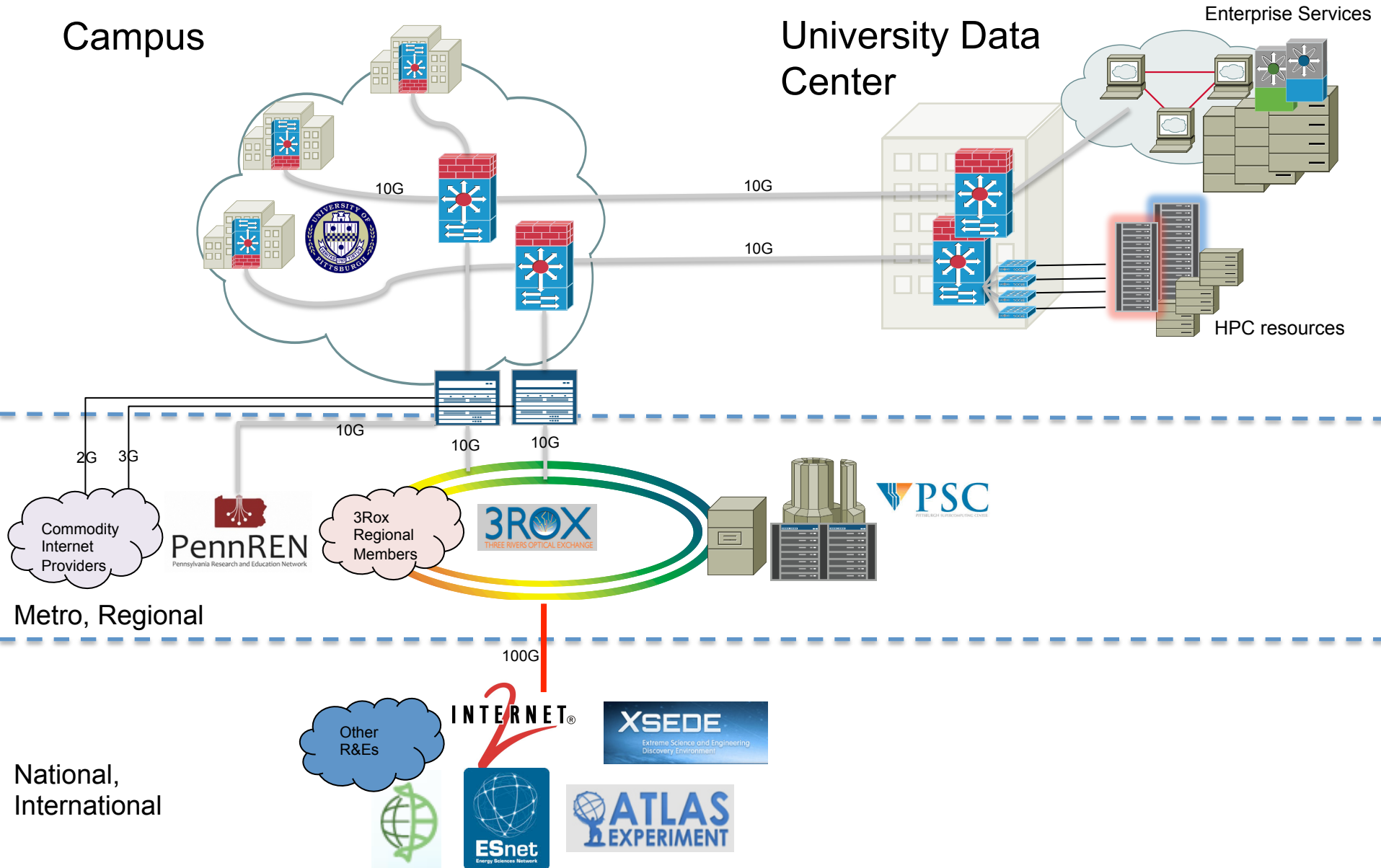
- **Our project** - *Accelerating Science, Translational Research, and Collaboration at the University of Pittsburgh Through the Implementation of Network Upgrades*
- Award amount - \$499K
- Period – Sept 2015 completion
- PI – Brian Stengel. Co-PI's – Chris Keslar, Dr. Michael Barmada (Human Genetics, SaM), Dr. Patrick Pisciuneri (Givi Group, SaM)
- Pitt research projects supported – PGRR (Pittsburgh Genome Resource Repository), LCTP (Laboratory for Computational Transport Phenomena – Givi Group), Physics/Astronomy – ATLAS
- Other orgs and groups we are engaged with – 3Rox/PSC, ESnet, Internet2, GRNOC, CTSC, US ATLAS



Campus

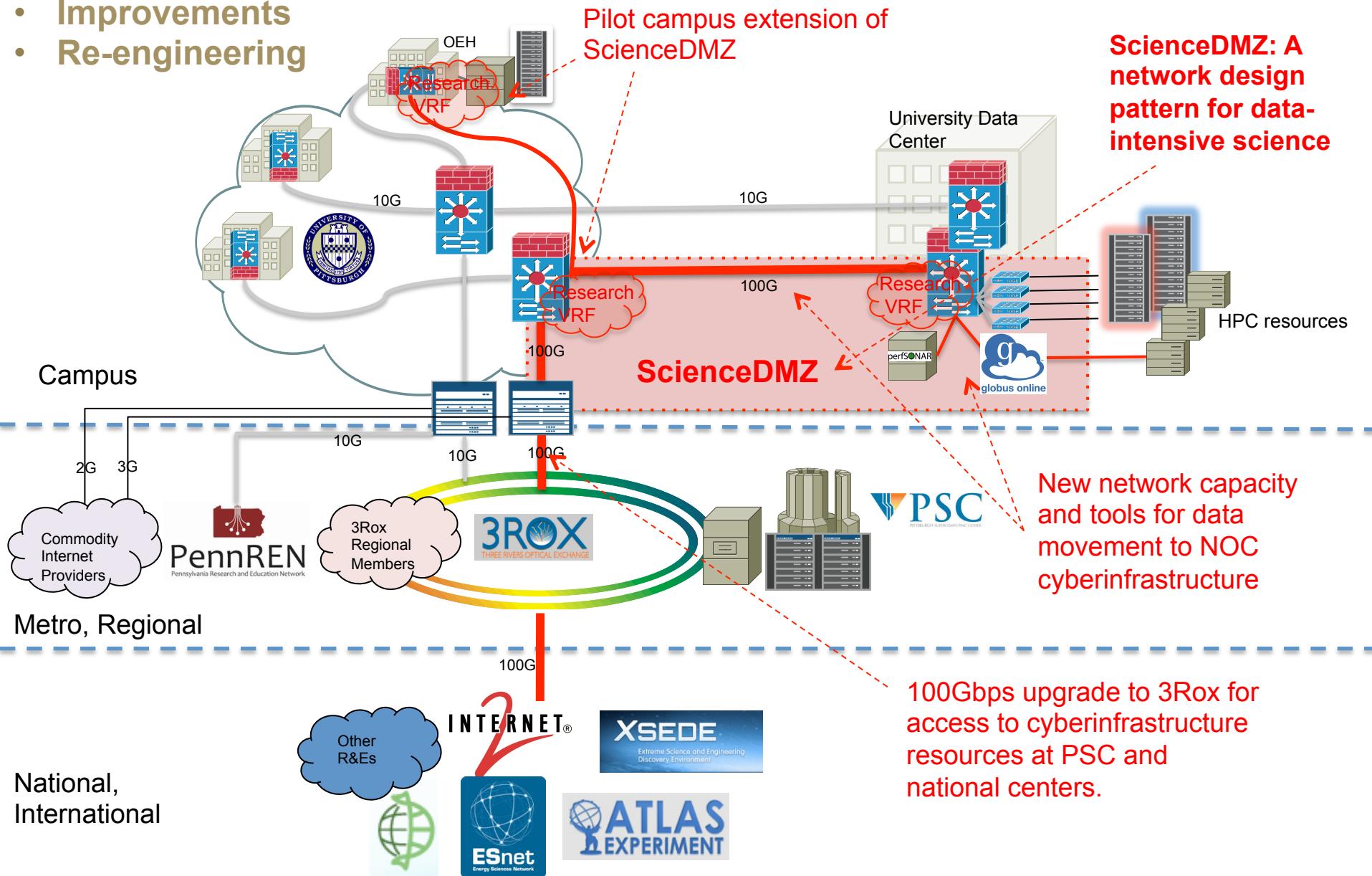
University Data Center

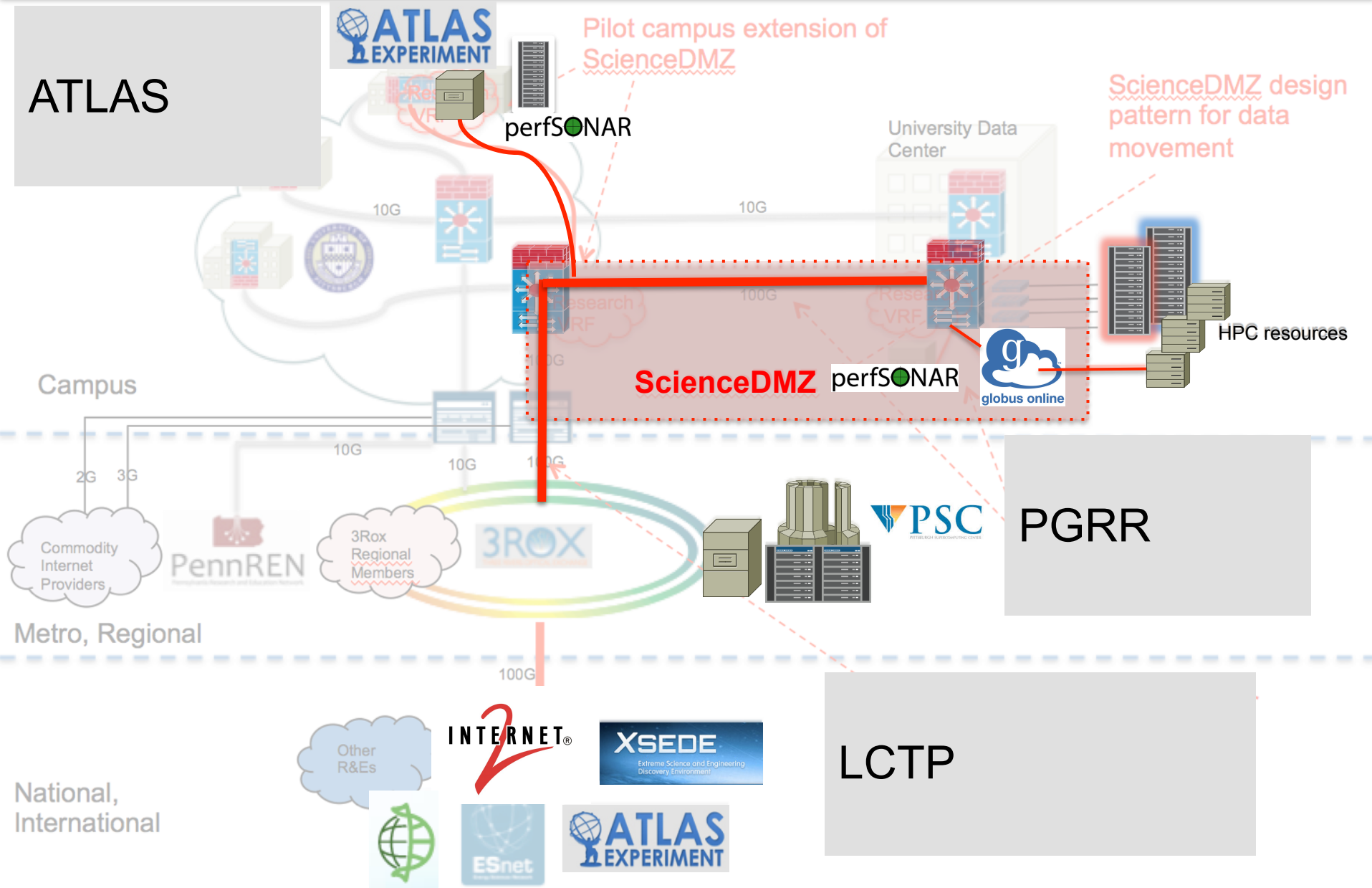
Enterprise Services





- Improvements
- Re-engineering

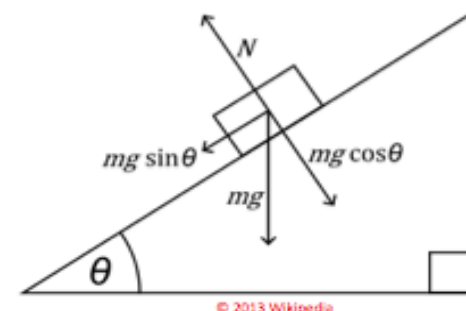




The Science DMZ in 1 Slide

Consists of **four key components**, all required:

- “Friction free” network path
 - Highly capable network devices (wire-speed, deep queues)
 - Virtual circuit connectivity option
 - Security policy and enforcement specific to science workflows
 - Located at or near site perimeter if possible
- Dedicated, high-performance Data Transfer Nodes (DTNs)
 - Hardware, operating system, libraries all optimized for transfer
 - Includes optimized data transfer tools such as Globus Online and GridFTP
- Performance measurement/test node
 - perfSONAR
- Engagement with end users



© 2013 Wikipedia



perfSONAR

Details at <http://fasterdata.es.net/science-dmz/>

2012-2014 National Science Foundation CC-NIE & CC-IIE Awardees

Connecting to National CI

- Using RENs
- Data, compute, other resources
- Scientific instruments
- Code, VMs, clouds
- People
- Organizations

Innovation,
Discovery

- Brings new opportunities for collaboration and use of CI
- Increases our competitiveness for grants and contracts...
- Opens up new services and modes of collaboration with peers (edu, orgs, people)...



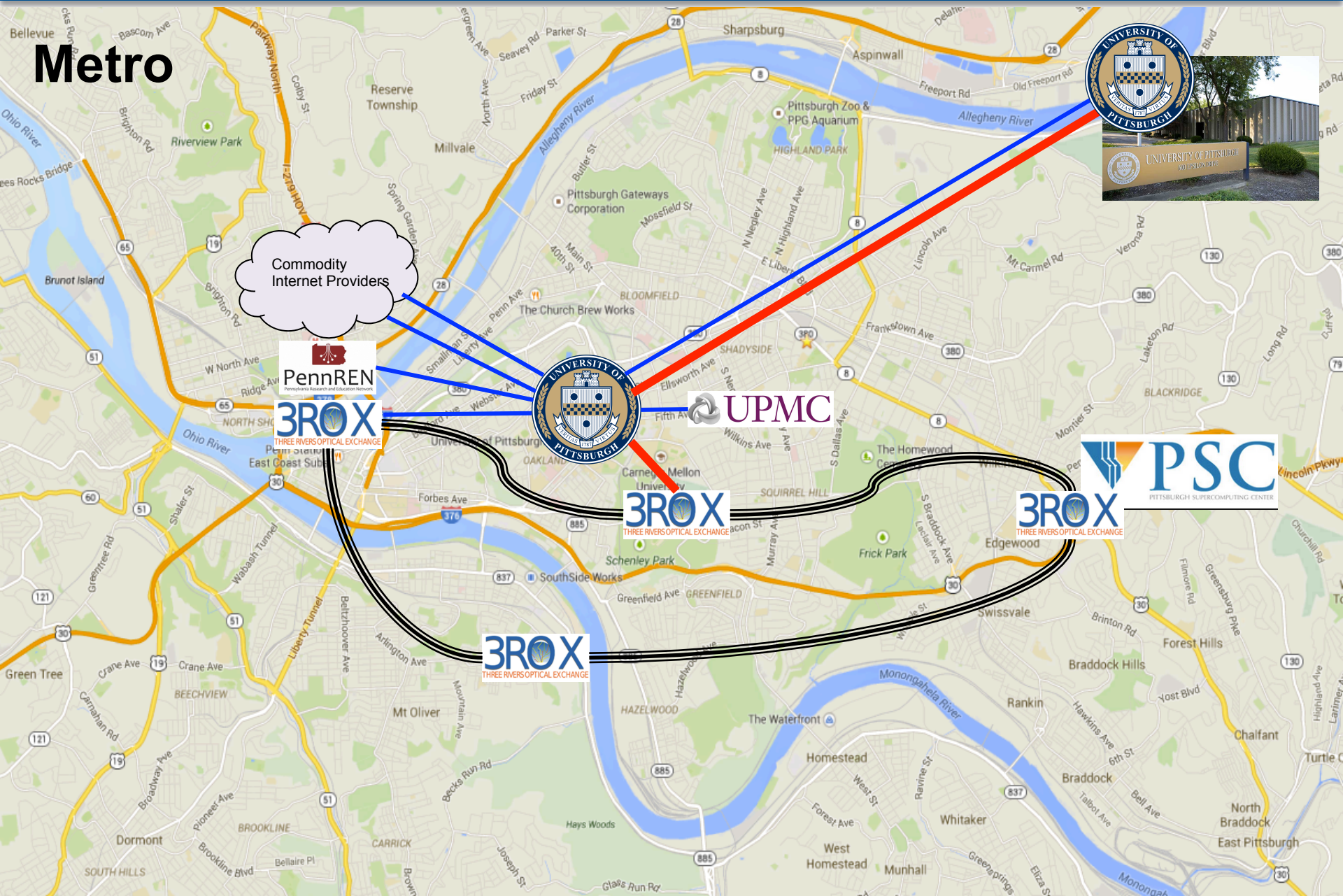
The Office of Science supports:

- 27,000 Ph.D.s, graduate students, undergraduates, engineers, and technicians
- 26,000 users of open-access facilities
- 300 leading academic institutions
- 17 DOE laboratories



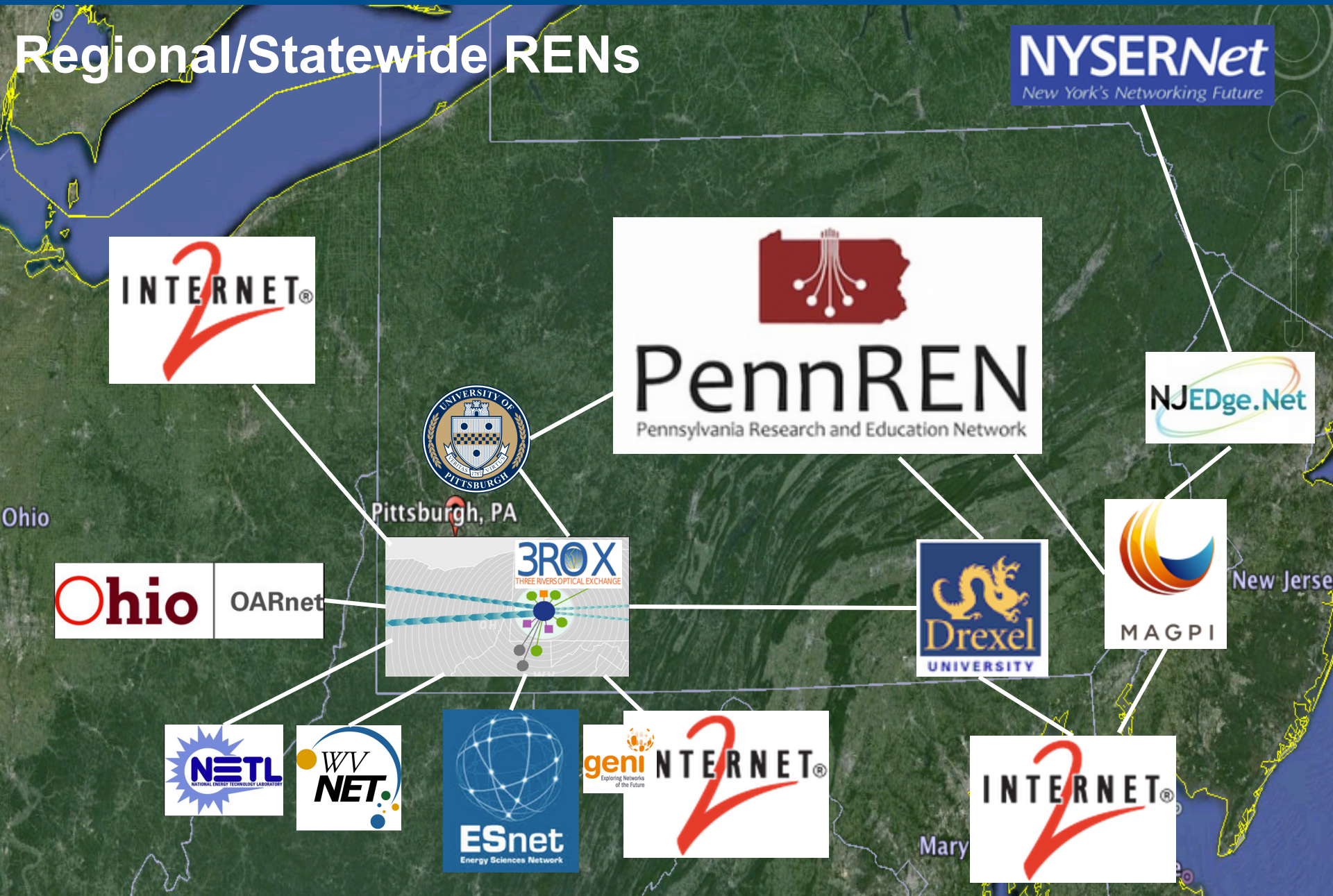


Metro





Regional/Statewide RENs





National / International

INTERNET2 ADVANCED NETWORKING





XSEDE

Extreme Science and Engineering
Discovery Environment

POWERED BY INTERNET²

National CI

ADVANCING XSEDE @ 100G

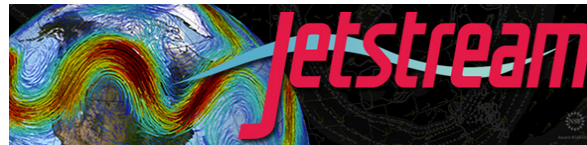


New NSF Funded Cyberinfrastructure



9.6M award to PSC

- Bringing supercomputing to non-traditional users and research communities
- It's data-intensive architecture (3 tiers of large, coherent shared-memory nodes) will allow HPC computing applied to big data
- Will bridge supercomputing to university campuses to ease access and provide burst capability



\$6.6M award to IU, TACC

- NSF's first cloud environment for science and engineering research
- "easy button" for simple access to supercomputing tools and data sets
- User-friendly cloud environment designed to give researchers access to computing and data analysis resources on demand
- Menus of "virtual machines" designed to support discipline specific computation



\$20M for new testbeds to support cloud computing applications and experiments

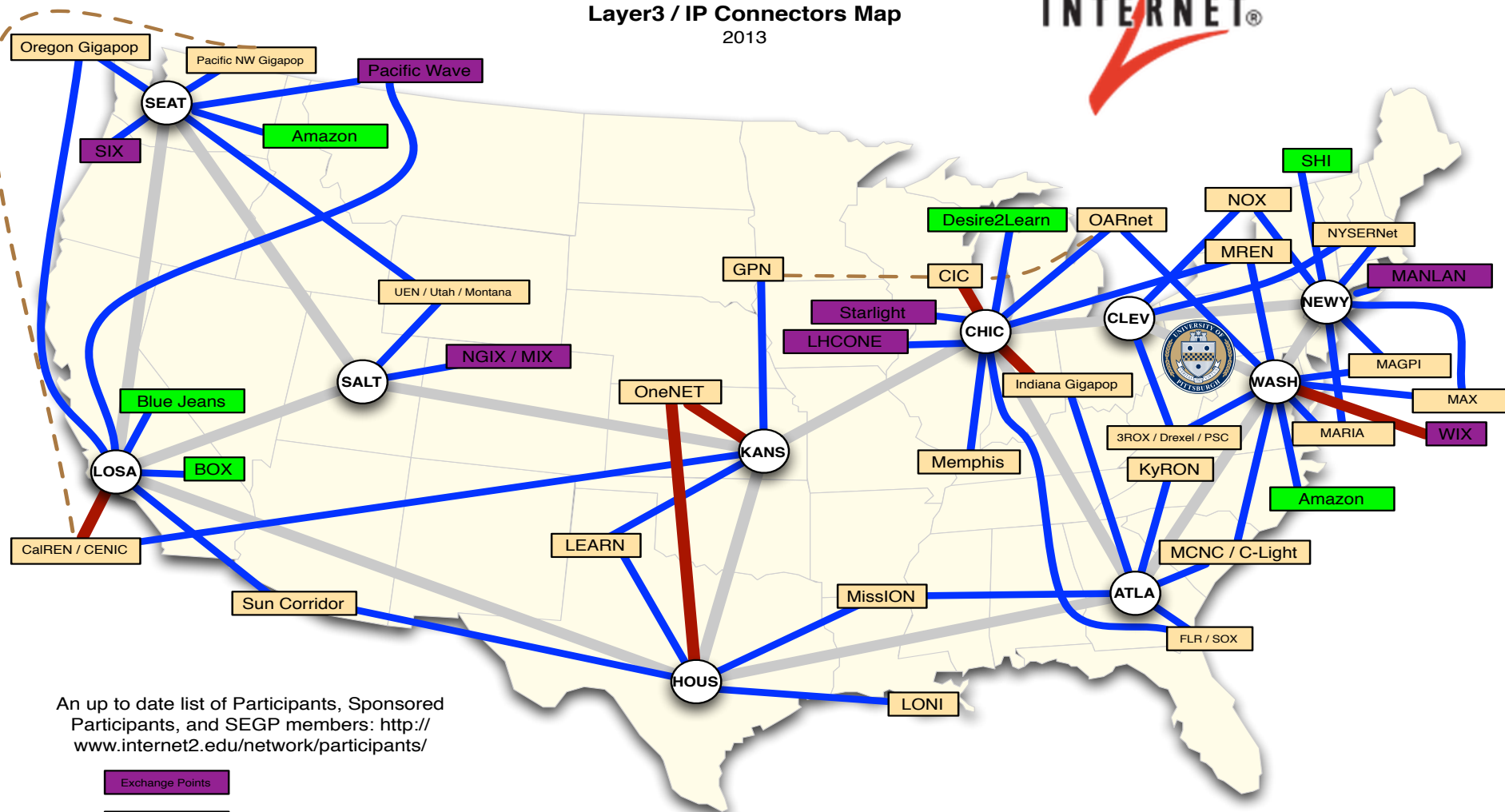
- Flexible, scientific infrastructure for research on cloud computing
- Researchers can build their own clouds, experiment with new architectures
- Distributed clusters providing compute, storage, software defined networking
- Federated with existing research infrastructure (GENI, USIgnite, others)



Internet2 Network

Layer3 / IP Connectors Map

2013



An up to date list of Participants, Sponsored Participants, and SEGP members: <http://www.internet2.edu/network/participants/>

- Exchange Points
- NET+ Peer
- Connector

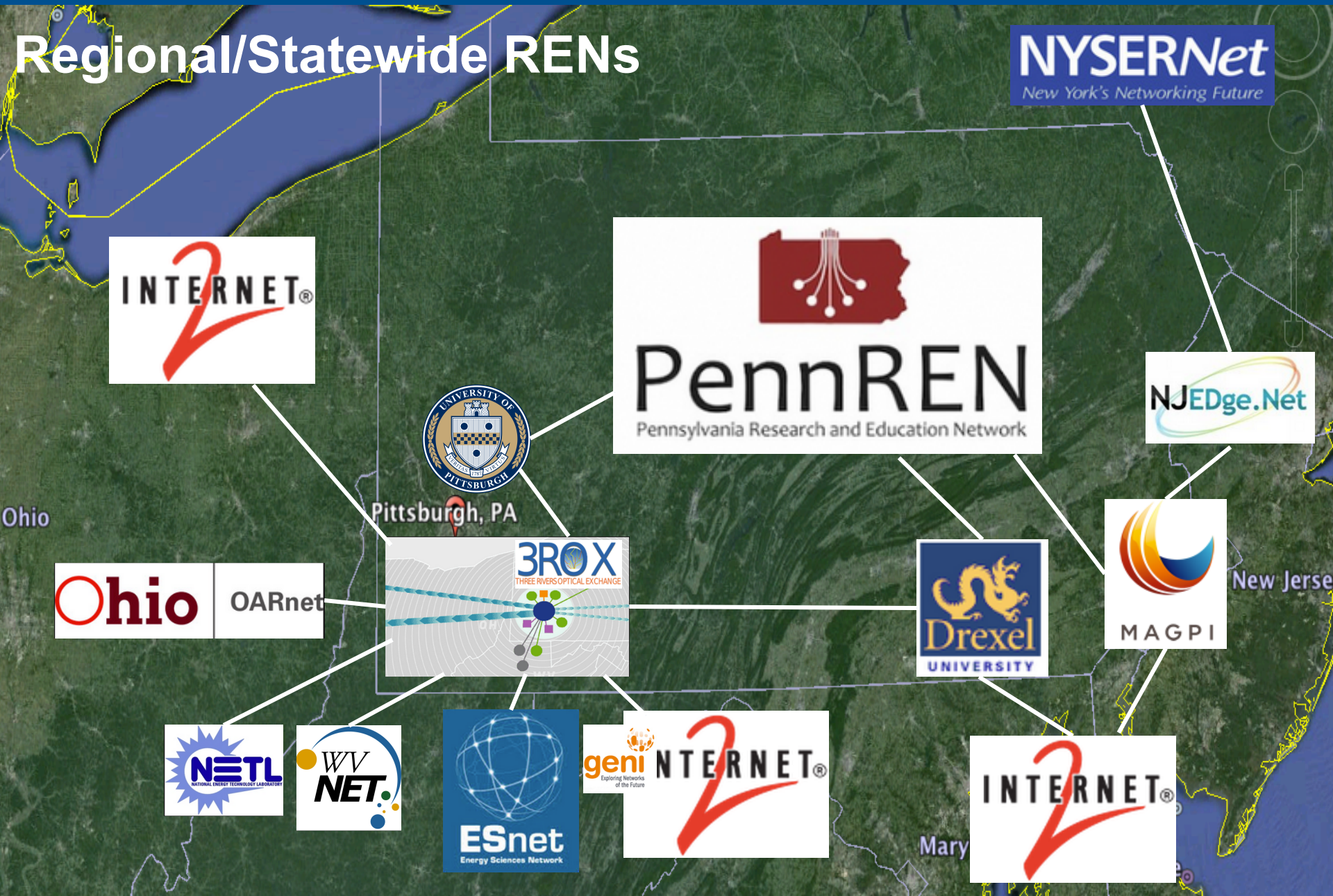


Why RENs?

- Why special networks? Why not use the ISPs?
- Reasons are both technical and social
- RENs serve scholarly purposes; ISPs serve commercial purposes
 - Enabling data intensive science (ScienceDMZ, etc..)
- The environment of RENs is collegial; for ISPs it is proprietary
 - Abundant bandwidth enables innovation (100G between campuses and users)
- RENs are collaborative; ISPs are competitive
 - Enabling innovation through open standards (SDN, Openflow, etc..)
- Internet2 and its communities are leading the way in developing the technologies to fully integrate as a user-and-application controllable, virtualized cyberinfrastructure



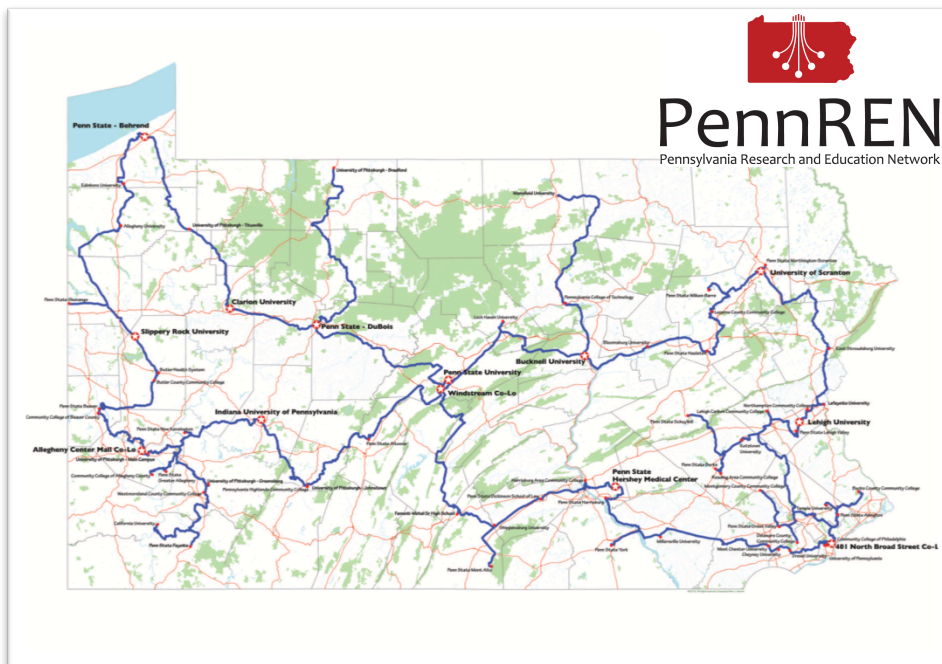
Regional/Statewide RENs



Pennsylvania's Research & Education Network

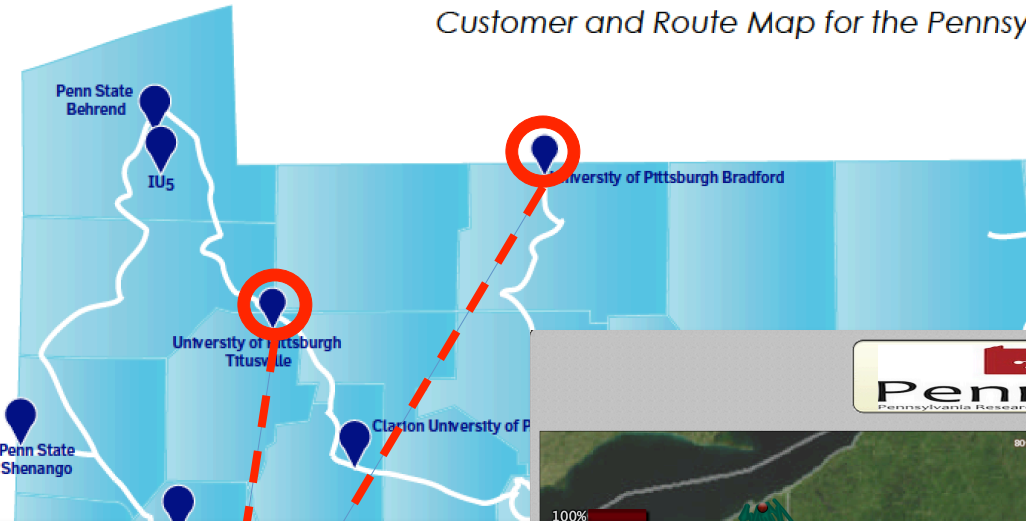


- A non-profit **MEMBER ORGANIZATION** that provides a variety of **BROADBAND CONNECTIVITY** solutions
- Fosters **COLLABORATION**
- Promotes **INNOVATIVE** use of **DIGITAL TECHNOLOGIES AND SERVICES**
- Brings resources to the **EDUCATIONAL, HEALTHCARE, LIBRARIES, MEDIA, GOVERNMENT and NON-PROFIT** communities in Pennsylvania



Keystone Initiative for Network Based Education and Research

Customer and Route Map for the Pennsylvania Research & Education Network



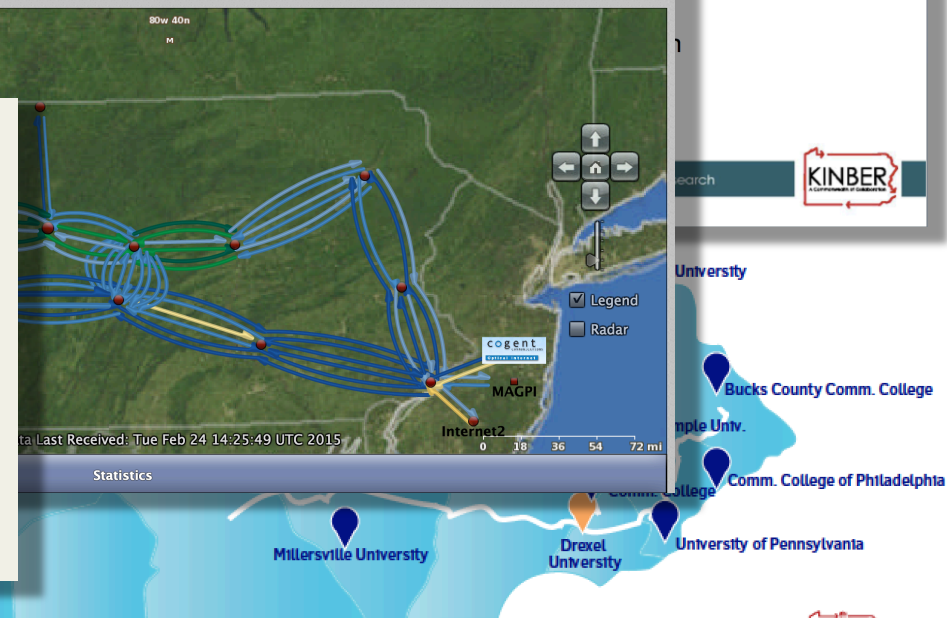
KINBER Members

- Pitt
- AICUP (Independents)
- Bucknell
- PASSHE System
- Geisinger Health System
- PAIUNET (K-12)



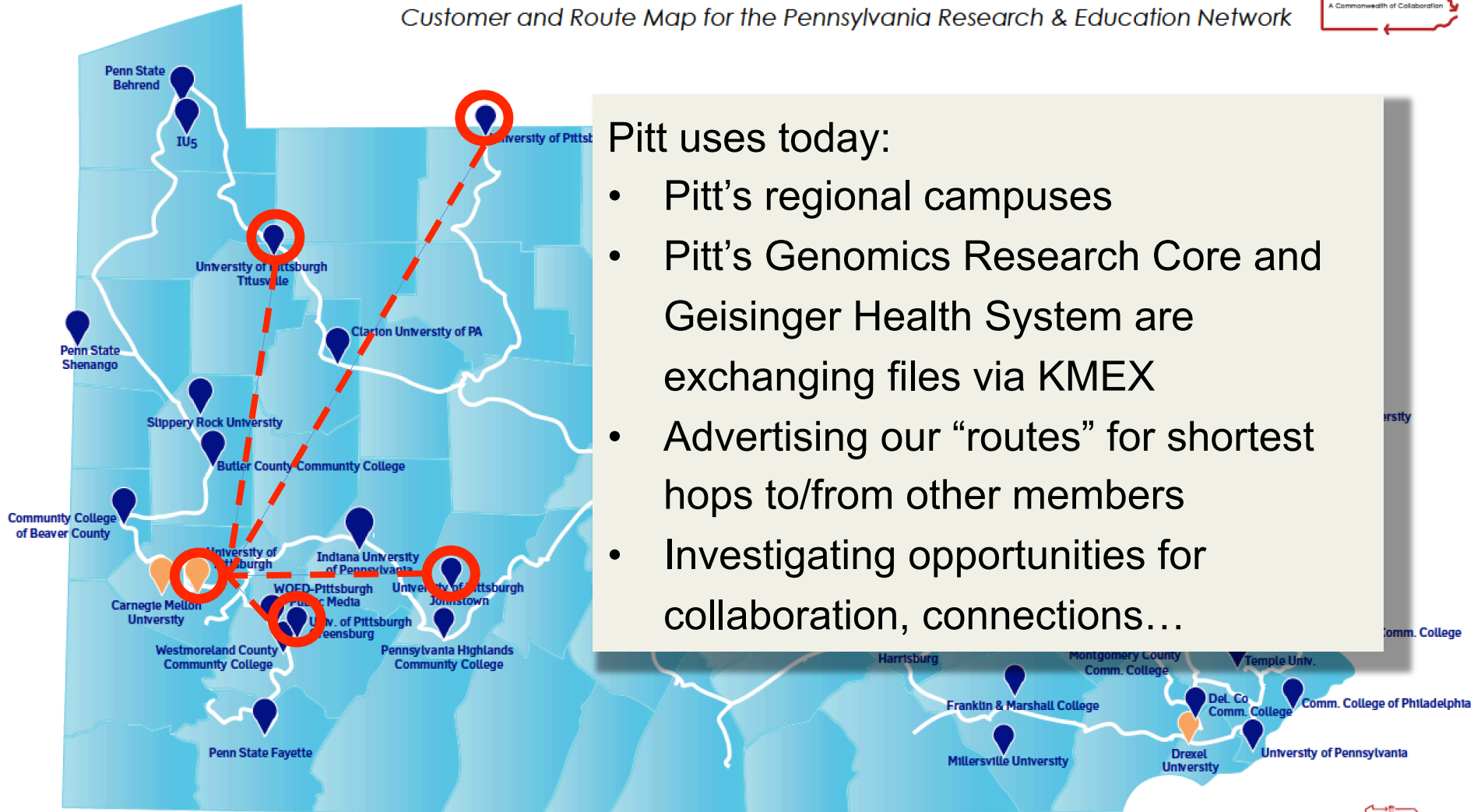
Services:

- Private connections
- Members exchange (KMEX)
- Dark fiber leasing
- Commodity services
- Partner provided services



Keystone Initiative for Network Based Education and Research

Customer and Route Map for the Pennsylvania Research & Education Network



Pitt uses today:

- Pitt's regional campuses
- Pitt's Genomics Research Core and Geisinger Health System are exchanging files via KMEX
- Advertising our "routes" for shortest hops to/from other members
- Investigating opportunities for collaboration, connections...

Keystone Initiative for Network Based Education and Research

Customer and Route Map for the Pennsylvania Research & Education Network



Opportunities:

- PINSE, IUP, Lehigh
- Port of Pittsburgh Commission's Wireless Waterways Network (Interoperability Test Bed)
- Energy Innovation Center





University of Pittsburgh

Mission

- Offer superior educational programs
- Advance the frontiers of knowledge and creative endeavor
- Share expertise with private, community, and public partners

Strategic Priorities

In advancing our mission, we will rank among the finest universities in the world, emphasizing as Strategic Priorities:

Consistently
Deliver Excellence
In Education

Impact Through
Pioneering
Research

Build
Community
Strength

Extend
Our Global
Reach

Provide
Top
Value

Secure an
Adequate
Resource Base

Drivers

As we strive for excellence and impact in advancing our mission and vision, we face profound challenges and opportunities in our region and the global landscape of higher education. These demand dynamic responses, presented here as **drivers** of foundational change

Partnering
for Impact

We will facilitate internal collaboration to enrich the interdisciplinarity of our academic endeavors and enhance operational efficiency; and actively pursue engagements with private, public, government, and international partners on strategic initiatives.

Harnessing
Information

We will transform the scale and impact of our activities by harnessing information in pursuit of grand challenges. This will drive innovative approaches to research, student learning and development, community and alumni engagement, and operational excellence.

Shaping Our
Culture

Ours will be a culture in which faculty, staff, students, and alumni all strive for excellence. We will invest in the continuous development of our people; and become more diverse and interconnected, agile in our decision making, and engaged as a community. With resiliency, integrity, and determination, we will be entrepreneurial and innovative in achieving impactful results.

Values

With respect for each other and our rich tradition, the University of Pittsburgh embraces as core **values**:

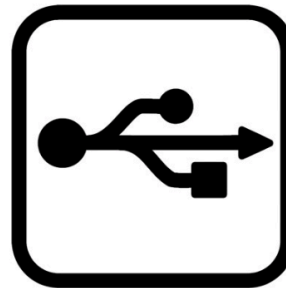
- Excellence, Impact
- Integrity, Virtue
- Collaboration, Collegiality
- Diversity, Inclusion
- Entrepreneurship, Agility



Summary

- Campus Cyberinfrastructure – *can we talk?*
- Regional, National CI – *we can make the connections*
- Data Movement/Mobility – *help us understand*
- Trust, Trustworthiness, Fed/Funder Compliance – *is important*
- Collaboration, Contracts, Proposals – *we can help*
- RENs will continue to lead the way in access to national CI

Cyberinfrastructure =



IT





InformationTechnology

Thank you!

Brian Stengel
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April 2, 2015

102 Benedum Hall 12:00~1:00pm

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PROFESSIONAL BRAND
WITH SOCIAL MEDIA**

WITH:

**Andrew Stephen
Katz School of Business**